
Idaho National Laboratory
Strategic Plan
Leading the Renaissance in Nuclear Energy
FY 2006-2015
INL
Idaho National Laboratory

INL/EXT-05-00739

INL: Leading the Renaissance in Nuclear Energy

MISSION

Ensure the nation's energy security with safe, competitive, and sustainable energy systems and unique national and homeland security capabilities

VISION

Within ten years, INL will be the preeminent nuclear energy laboratory with synergistic, world-class, multiprogram capabilities and partnerships

PRINCIPAL PRIORITIES

- World-leading safety behavior, safety performance, and environmental stewardship
- Respect and caring for our people
- Mission accomplishment

This Strategic Plan presents the objectives that will transform the Idaho National Laboratory during the next decade. The objectives necessary to deliver the INL vision are defined in five areas:

- Build our nuclear energy leadership
- Build our national and homeland security leadership
- Focus our multiprogram science and technology portfolio on energy security
- Develop our supporting science and engineering capabilities and revitalize U.S. nuclear science and engineering education, academic research, and training
- Enable the strategy by addressing fundamental needs for revitalized infrastructures, public trust and confidence, and excellence in laboratory operations and management.

This plan summarizes the new foundations and specific actions our laboratory must execute for this ambitious agenda. A timeline at the end of the plan summarizes the key INL milestones.

"Here in Idaho, we will have the premier facility for nuclear energy in the country. You all will be instrumental in reviving nuclear power."

Energy Secretary Samuel Bodman visited the INL on Wednesday, June 1, 2005, for the opening of the new Center for Advanced Energy Studies (CAES).

Leading the Renaissance Through Transformation

John J. Grossenbacher

The new century brings many challenges to America and the world. In addition to a global War on Terrorism, the 21st century confronts us with the realization that the availability, affordability, environmental impact, and security of energy must be addressed now. With decisive and prudent action, we can have a major impact on energy availability with all that entails for the developed and developing world.

These challenges call for a renaissance in nuclear energy. They offer an unprecedented opportunity for those who lead and undertake the necessary research, technology development, and systems demonstration. We must step up to these challenges.

Leading the new Idaho National Laboratory (INL) is both an honor and a challenge—we must have the creativity and initiative of all who work at INL and earn the support of our many stakeholders.

To understand the magnitude of the transformation in our laboratory that is required, we must look ahead to the end of the first decade of the new INL. We will see nuclear energy and national and homeland security leadership highlighted by such achievements as the demonstration of Generation IV reactor technologies; the creation of national user facilities based on the Advanced Test Reactor and the Critical Infrastructure Test Range; the piloting of advanced fuel cycle technology; the rise to prominence of the Center for Advanced Energy Studies; and INL becoming a world leader in safe operations. Also, as the Idaho Cleanup Project comes to a successful close, INL must ultimately take on the responsibility for future environmental stewardship.

This transformation will be propelled by our many accomplishments, including refurbished infrastructures; supporting networks involving universities, industries, and other national laboratories; nine research centers driven by five distinctive signatures in science; the best researchers working in state-of-the-art facilities; and a long series of impactful INL contributions to America's energy security.

This exciting landscape will reveal itself only with planning, unprecedented performance, and an enormous amount of hard work in execution. INL's Strategic Plan is an outline for leadership of a renaissance in nuclear energy. Within these pages you will see the beginning of the dedicated effort to build a laboratory that inspires our people, intensifies and accelerates our research, and leads us to our many achievements.

We are excited about INL's future as we embark on this important journey—a journey that will lead us to recognition as a great and enduring laboratory. Join us in this vital effort.

Director, Idaho National Laboratory and
President, Battelle Energy Alliance, LLC.

Nuclear Energy Leadership

Nuclear energy holds enormous potential for the future and will benefit America and the world with safe, secure, environmentally responsible, and affordable energy while reducing our nation's dependence on foreign sources. This potential provides the opportunity for a nuclear renaissance. And it is being recognized by endorsements for nuclear energy from a broad spectrum of people around the globe, including prominent environmentalists. It also offers opportunities for leadership—and better lives for the people of all nations.

Dr. Jim Lake (left) briefs President George W. Bush (center) and Secretary of Energy Samuel Bodman (right) on INL's contribution to national energy needs.

Strategic Objective –

Lead and Deliver a Generation IV Reactor

Five years ago, the United States and ten international partners began to study global nuclear energy needs and developed a roadmap for 21st century nuclear energy technology. A group called the Generation IV International Forum (GIF) has identified promising nuclear energy systems for the economical, safe, sustainable, proliferation-resistant, and secure production of energy. A major step toward advancing these nuclear energy systems is the next generation nuclear plant, authorized in the Energy Policy Act of 2005, a proposed project to demonstrate hydrogen and electricity production by about 2020. The reactor is based on the very-high-temperature, gas-cooled reactor (VHTR) system in Generation IV that has the potential to produce hydrogen and electricity very safely, economically, and without the emission of greenhouse gases.

Having diverse expertise and a long-standing nuclear energy history, INL is uniquely positioned to lead and deliver a Generation IV reactor based on strong research, development, and demonstration partnerships.

INL will contribute to this and other history-making reactor demonstrations by leading the nuclear energy research, development, and demonstration and by assembling the needed resources through industrial, laboratory, and academic networks. Initially, the INL and its partners will deliver research and technology development for the VHTR. This will focus on the behavior of high-temperature gas reactor fuels, materials qualification, developing and validating design methods, hydrogen production, and energy conversion.

Strategic Objective –

Lead the Global Nuclear Energy Agenda

Realization of nuclear energy's potential will be greatly accelerated when developers around the world join together on the science and technology challenges and focus their collaborations on the most promising solutions. INL will assemble and lead a group of preeminent research directors and policy experts from industry, academia, national laboratories, and government, along with their international committees of experts working through the Center for Advanced Energy Studies (discussed later). These committees will review research developments and outlook, and report annually to advise on needed direction and related progress, and to identify resources. The nuclear agenda will inform programs worldwide, providing needed direction and setting priorities, and will stimulate concerted action.

The signing of the GIF Framework Agreement in February 2005, establishes the basis for international research collaboration on Generation IV systems.

counterparts in the nuclear community, to develop an integrated global nuclear energy agenda.

Development will begin with the creation of a national agenda in 2006 and, under the auspices of GIF, expand in later years to an international agenda. The development of these yearly agendas will be informed in part by topical

With the signing of the GIF Framework Agreement in February 2005, international collaboration has taken a big step forward — laying the groundwork for multilateral contracts for research collaboration on Generation IV systems. This enables broad collaboration on common goals and the advancement of a global nuclear energy agenda.

Strategic Objective –

Build the Fuel Cycle of the Future

The fuel cycle of the future in the world must effectively address the waste, safety, security, and economics of an expanding civilian nuclear energy fleet. It must also ensure that concerns about nuclear proliferation are properly addressed. The challenges will be met by developing, demonstrating, and optimizing an integrated and evolving fuel cycle that considers current needs, then by transitioning to meet the

INL scientist inspects a centrifugal contactor, the central component of the aqueous method of nuclear fuel processing.

future needs of a closed fuel cycle. The U.S. will benefit by leading the advances internationally, and by applying the advances to our own fuel cycle where appropriate. The INL will be a leader in those advances.

This challenge is currently being addressed by the Advanced Fuel Cycle Initiative (AFCI). INL has leadership roles in fuel separations technology, fuel development and testing, and systems analysis. In separations technology, the AFCI has been examining the benefits and costs of recycling used nuclear fuel, and is planning to begin a pilot fuel cycle laboratory at INL within five years, known as the Advanced Fuel Cycle Facility (AFCF). The foundations for this laboratory are actinide chemistry and chemical engineering expertise, and one-of-a-kind infrastructure for both aqueous and pyrochemical separations research. The AFCF will be a versatile test bed and center of excellence for understanding and scaling-up the most promising fuel separations technologies.

Scientist loading experimental fuel assembly into the Zero Power Physics Reactor (ZPPR) core, a split-table type critical reactor.

Complementing separations technology, INL's fuel development and testing abilities are already world-class in several technical areas, and are strong in others. These capabilities are being enlisted by other programs to improve the performance of commercial light-water reactor fuels and to convert research reactors worldwide to low-enriched uranium fuel. INL's fuel development and testing capabilities are the foundation for developing new fuels to meet the challenge of burning or transmuting long-lived actinides separated from used nuclear fuel.

A health physics technician works with the radiation hot cell in INL's Space Battery Building.

Systems analysis is key to leadership in the fuel cycle of the future. The results of systems analysis that study the behavior of future fuel cycles under various scenarios will aid decision makers in selecting the best processes and reactor technologies and in formulating the steps to deploy them. This enables rapid progress toward the long-term national goals of sustainability, proliferation resistance and physical protection, uranium resource extension, and an economical and safe closed fuel cycle.

Strategic Objective –

Power Space Exploration for the Nation

The United States is exploring the solar system—an ambitious mission requiring new energy systems for deep space, the moon, and Mars. During the next decade, INL will undertake a larger role in powering this exploration. In support of NASA, INL will lead key activities to develop the radioisotope and nuclear power and propulsion technologies needed for multimission spacecraft and human exploration.

The INL has been identified as the preferred site for consolidating DOE nuclear operations associated with the radioisotope power systems for NASA and other customers.

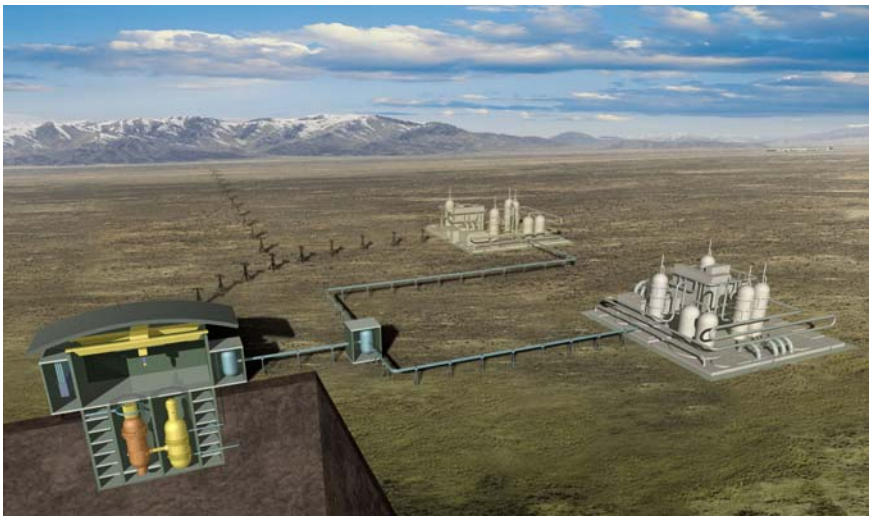
Assembling and testing the radioisotope thermoelectric generator for the New Horizons mission to Pluto will be the first major contribution. INL will then undertake the full range of activities supporting the production of radioisotope power systems to support DOE plans to consolidate its complex-wide operations in Idaho before 2012. This mission will be undertaken with a transparency and integrity that will build public confidence.

In forming this space nuclear program, INL is partnering with the Universities Space Research Association, the University of New Mexico, and General Atomics to create a Center for Space Nuclear Research in the fall of 2005. The Center will broadly address technology needs for space nuclear power and propulsion systems to meet the needs of space exploration over the long term. Additional partners will include NASA, DOE laboratories, and Idaho universities.

Strategic Objective –

Build Strategic Relationships with Industry Organizations and Regulators

Three industry-derived organizations support the U.S. nuclear industry: the Electric Power Research Institute (EPRI) supplies tactical and strategic technology development; the Institute for Nuclear Power Operations (INPO) supports operational excellence through training,



A conceptual drawing of the Very-High Temperature Reactor, one of the six concepts selected by the Generation IV International Forum.

assessment, and assistance activities for commercial nuclear power operators; and the Nuclear Energy Institute (NEI) manages the industry interface with federal regulators and the federal government. Building strategic relationships with these three organizations will help align INL with the vision and growth strategies of the commercial industry in the areas of technology development with EPRI, operational excellence and training with INPO, and industry and federal initiatives with NEI.

At the same time, it is also important to enhance relationships with the U.S. Nuclear Regulatory Commission (NRC) and other regulators internationally. INL has a long history of service to the NRC, with groundbreaking safety experiments and innovative analytical tools. These have helped to create a regulatory framework and practices that are recognized worldwide for their effectiveness. However, evolving regulatory paradigms, new reactor technologies, and diverse applications of nuclear energy create new and complex regulatory challenges. INL will strengthen its relationship with the NRC to meet these challenges with renewed collaboration.

Key Milestones for Nuclear Energy –

- Co-locate the EPRI Fuel Reliability Program at INL 2005
- Establish the Center for Nuclear Fuels and Materials Research (CNFMR)..... 2005
- Establish the Center for Space Nuclear Research (CSNR)..... 2005
- Establish the Center for Nuclear Systems Design and Analysis (CNSDA)..... 2006
- Submit CD-0 (mission need) documentation for the Advanced Fuel Cycle Facility (AFCF) 2006
- Deliver the radioisotope thermal generator and support the launch of the New Horizon Mission to Pluto 2006
- Complete Advanced Test Reactor (ATR) upgrades..... 2010
- Begin initial Advanced Fuel Cycle Facility (AFCF) pilot operations ..... ~2010
- Begin production of radioisotope thermoelectric generators and power systems at INL 2011
- Grow nuclear energy programs to $250M annually 2015
- Start operation of a Generation IV reactor ..... ~2020

National and Homeland Security Leadership

Ensuring the nonproliferation of weapons of mass destruction and keeping America's citizens and their critical infrastructures (power grids, communications, airports, etc.) safe and secure are essential and demanding priorities. To support this objective, INL conducts research and provides technology and systems to support U.S. global security, homeland security, national defense, special programs, and energy security clients.

INL engineers designed and fabricated a one-of-a-kind series of stainless steel modules to assist the U.S. Army with the assessment of non-stockpile chemical material.

Strategic Objective –

Build Five Primary Development and Test Capabilities and Two Technology Platforms into Leading Roles in Nonproliferation and Critical Infrastructure Protection

INL's nuclear expertise, extending through the entire nuclear fuel cycle, has broad application to national and homeland security. National security experts at INL will work closely with its nuclear energy R&D teams to build the laboratory's role in nuclear materials nonproliferation, safeguards, and security for the National Nuclear Security Administration and other national and international clients. The laboratory will build its leadership in proliferation-resistant reactor and fuel cycle designs and safeguards with a Center of Excellence for Nonproliferation Safeguards and Security in 2009. This foundation for technology development will help enable the global deployment of advanced reactors.

INL's capabilities and expertise, based on a secure and isolated infrastructure, will also be developed to enhance critical infrastructure protection for the nation. Through the use of the existing Critical Infrastructure Test Range, INL will enhance its capabilities as the leading center for protection of the nation's critical infrastructure with emphasis in the areas of energy distribution, process control systems, and communications. In the near term, INL will distinguish itself by focusing on the following five primary development and testing capabilities:

Nonproliferation, Safeguards, and Security Technology. INL's foundation of more than fifty-five years of nuclear design and testing brings leadership to a broad array of nonproliferation technologies important to the national and international community: nuclear materials security, signatures, and detection; advanced nuclear energy safeguards, training, and testing; and evaluation of policy, solutions, and services. This capability will support the development of the Center of Excellence for Nonproliferation Safeguards and Security. In addition, the INL is well suited to be the leader in testing, evaluating, and deploying new systems in safeguards and security. With the draft Memorandum of Agreement between the Office of Security (formerly, Office of Safeguards and Security Administration) and Idaho Operations Office, several new technologies will be evaluated: Stabilized Panoramic Intrusion Detection System,

Perimeter Surveillance Radar System, Remote Detection and Tracking Sensor, Remote Operated Weapons System, and situational awareness/SITCOM. Other new technologies could potentially be piloted in the future to meet the 2004 DOE Design Basis Threat.

Supervisory Control and Data Acquisition/Cyber/Power Grid Security. INL engineers have designed, built, and operated a power-distribution system complete with an isolated, controlled transmission loop. Along with an internationally recognized cyber security program, this infrastructure and expertise will address the threats to electric power security and reliability from terrorism. This capability, along with wireless technology testing, will be the basis for a Department of Homeland Security/ Department of Defense Center of Excellence for Critical Infrastructure Protection in 2008, leading to a Center of Excellence for Electric Grid Reliability for the electric power industry and government agencies in 2010.

Communications Systems and Wireless Technology. INL will position its Wireless Test Bed, low-radio-frequency noise environment, National Telecommunications and Information Administration experimental station designation, and telecommunications expertise to focus on national security. The laboratory will offer industry and government large-scale testing of cellular and microwave communications, land mobile radios, wireless local area networks, and satellite systems.

Trace Explosives Detection and Testing. Expertise in ion mobility and secondary ion mass spectrometry will be focused on the detection of explosives. Demonstration of explosive effects will range from trace to bulk quantities. These capabilities will also extend to detection of other contraband for national and homeland security clients.

Unmanned Aerial Vehicle and Sensors Test Bed. The laboratory's remote location and controlled boundaries offer unique unmanned aerial and ground vehicle testing, as well as evaluation of sensors for national security clients.

INL engineers and scientists designed the Idaho Explosives Detection System for remote cargo inspection in vehicles.

The Portable Isotopic Neutron Spectroscopy (PINS) system is used to identify the contents of munitions that possibly contain chemical warfare materials.

INL's Unmanned Aerial Vehicle team perform a pre-flight inspection. The INL UAV team operates a test facility to explore range, payload, communications, and mission operations for DoD customers.

In addition to specific development and testing capabilities, the laboratory will focus on two primary technology platforms: materials applications and process controls.

Materials Applications: The laboratory has a rich history in understanding the behavior of materials in aggressive environments. This will be directed to the development and application of materials for innovative sensors, defense materials with superb performance, nuclear fuels with improved nonproliferation characteristics, and a light armor development and manufacturing capability that is unique within the national laboratory system.

Process Controls: The laboratory also has a rich history in the design, development, prototyping, testing, and demonstration of complex engineered systems, such as nuclear reactors, reprocessing and waste handling, and special defense command and control systems. This capability will focus on process control technology for protecting the nation's critical Supervisory Control and Data Acquisition (SCADA) systems.

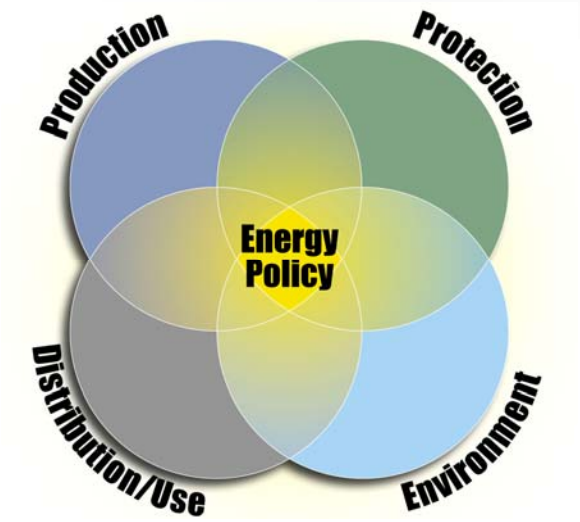
The Wireless Testbed offers large-scale, independent, end-to-end testing of wired and wireless next-generation communication infrastructure to commercial and government entities.

Key Milestones for National and Homeland Security –

- Develop a DHS/DOD Center of Excellence for Critical Infrastructure Protection..... 2008
- Develop a Center of Excellence for Nonproliferation Safeguards and Security..... 2009
- Create a Center of Excellence for Electric Grid Reliability 2010
- Grow national and homeland security programs to $205M annually 2015

Science and Technology for an Energy Security Portfolio

Energy security is of paramount importance to the nations of the world. INL will be distinguished by contributing to scientific research and innovations in science and technology that will address the four challenges of energy security, shown in the figure below.



INL provides integrated science and technology solutions that address the production, protection, distribution and use, and environmental challenges of energy security. This research contributes to informing, creating, and fulfilling America's energy policy.

Strategic Objective –

Establish a Vital Energy Security Business

INL will address the challenge of energy production by continuing to increase its contributions in technology development for fossil fuels, geothermal, bioenergy, and other renewable energy sources. In the long term, hydrogen production, delivery, and use will be of special importance, the principal goal being to revolutionize transportation systems. The number of research proposals will be increased to address these challenges, which will help increase the level of peer-reviewed scientific contributions by the laboratory. Overall, the cumulative award of competitive research grants is targeted to grow to $50M within five years.

INL will work toward increasing the balance, diversity, efficiency, and affordability of domestic energy sources to avoid the issues and costs of an over-dependence on imported energy sources. This includes modernizing the nation's deteriorating energy infrastructure to ensure safe, secure energy generation, distribution, and use. Technology solutions will also improve the protection of this critical energy infrastructure to ensure safe, secure, energy generation and distribution. Significant effort will be focused on work to improve energy conservation and to ensure that every aspect of energy production, delivery, and use is pursued in an environmentally sound manner. This includes innovative solutions for long-term environmental stewardship and waste management, and bringing insight to broader issues such as global warming and water resources.

INL's 500 kWe integrated fuel processor is the largest first-generation reformer in the world, and converts high-sulfur NATO-76 diesel fuel into hydrogen-rich gas for use in a fuel cell system.

Key Milestones for the Science and Technology Portfolio –

- Initiate Synfuels Production Program 2007
- Earn a cumulative $50M in competed research grants 2010
- Grow energy security programs to $120M annually 2015
- Develop hydrogen production technology for large-scale transportation needs ..... ~2020

Partnerships: A Common Objective

One objective supports all areas of the multiprogram laboratory, including nuclear energy, national and homeland security, and science and technology partnerships.

Jack Lance (left) welcomes Jeffrey Parker, Canadian Consulate General, and a 45-member Canadian delegation to INL to discuss areas of collaboration, joint research, and transfer/ commercialization of INL technologies to the marketplace.

Strategic Objective –

Deliver Innovative Technology through Strategic Partnerships and Effective Commercialization

U.S. competitiveness in the global technologies market requires strong partnerships and business agreements between commercial industry and the laboratory. With a vigorous business approach, these industrial partnerships will mobilize the development and testing of new innovations and effectively commercialize technology. Several areas present opportunities:

- The broad range of energy technologies in the energy security portfolio
- Nuclear fuels and materials research supporting current and future generation reactors, founded on a new Center for Nuclear Fuels and Materials Research in 2005, with operations at the Materials and Fuels Complex and offices in the Center for Advanced Energy Studies (shown under nuclear energy, and science and engineering capabilities milestones)
- Irradiation testing and development of advanced fuels and materials in the Advanced Test Reactor, which will be established as a national user facility in 2007 (shown under science and engineering capabilities milestones)
- Establishing a Center of Excellence for Electric Grid Reliability for the electric power industry by 2010 (shown under national and homeland security milestones).

The foundation for business agreements that deliver on these opportunities is the *Use Permit*, a prime contract provision that will allow the laboratory to serve commercial customers more directly, in a more business-to-business fashion. In addition to the *Use Permit*, industry funding will be acquired through work-for-others and cooperative research and development agreements. Programmatic funds may also be sought, when appropriate.

INL houses an independent, secure electric power grid (complete with functioning substations and over 60 miles of transmission line) which is used to test both physical and cyber vulnerabilities in the nation's electric power grid.

Distinctive Science Signatures

Science and engineering will be strengthened to support INL's nuclear energy and national and homeland security leadership and its energy security portfolio. This will be accomplished by establishing five distinctive scientific signatures; revitalizing U.S. nuclear science and engineering education and training; and creating resource networks among industry, academia, and national laboratories to bring to INL the talent and resources needed for major projects and scientific advances.

Strategic Objective –

Establish a Robust Science Base with Five Distinctive Scientific Signatures

After more than a half century as an engineering laboratory, INL will significantly expand its science base by developing five distinctive scientific signatures. These scientific signatures (defined below) will be the foundation for nuclear, fossil, renewable energy, and environmental systems research and national and homeland security testing and demonstration.

Within the next five years, the laboratory will develop and implement plans (known as *roadmaps*) for each distinctive scientific signature that will guide the growth of INL's science base. The decade-long transformation to a robust science and technology portfolio will produce scientific discoveries and increase publications. The signatures will support the application of scientific advances to the missions and will help transform our culture toward scientific inquiry. The distinctive signatures will serve to attract preeminent scientific researchers, foster new program opportunities, engender a refreshed scientific spirit, and promote the recognition that INL offers unique scientific and technical careers. The five distinctive scientific signatures are:

Advanced Materials and Nuclear Fuels integrates the physical understanding of the processing, structure, and properties of materials under demanding conditions, along with in situ validation of performance models, to deliver energy systems with advanced performance and reliability. While this signature focuses on nuclear energy, it crosscuts other energy systems, hydrogen generation and storage, and national security. This signature also aligns with the signatures of Theory, Modeling, and Simulation; and Instrumentation, Control, and Intelligent Systems.

Theory, Modeling, and Simulation encompasses the tools to advance the theory of basic processes and the design of complex energy systems using advanced numerical modeling and computer simulations. This signature will be based in the Center for Advanced Modeling and Simulation in 2006. It will enable a suite of modeling and computing capabilities and link to leadership-class computing at other laboratories.

INL scientists, in collaboration with MIT, have conducted the largest single body of fundamental research regarding heat and mass transfer using gas metal arc welding processes during the fabrication of pressurized vessels.

Dr. Deborah Newby is adding a solution to a 96-well micro titer plate containing fluorescently labeled DNA. Subsequently, that material will be sequenced using DNA analysis.

Separations and Actinide Science integrates and expands research capabilities for basic, fundamental, and applied research and fosters university research to support development of the next generation of used nuclear fuel separation processes. In addition, the signature underpins the actinide science needed to develop new reactor fuels, transmute transuranic wastes, and deliver advanced waste forms. This will be based in the Advanced Fuel Cycle Facility by about 2010.

Microbiological and Geological Systems Science provides the ability to assess, understand, predict, and control complex microbiological processes within the context of their environment. A systems biology approach is used to understand and manipulate microorganisms, from the genome to the community level, within their ecosystems. This approach, combined with experimental investigations and modeling of coupled biohydrogeochemical processes from the nano- to field-scale, will produce unique capabilities and technologies for addressing water quality and quantity and energy recovery, production, and utilization issues.

Instrumentation, Control, and Intelligent Systems encompasses on-line monitoring, diagnostics, prognostics, information visualization, situational awareness, human system interface, intelligence, augmented control and automation, and performance enhancing/risk reducing solutions for the human-machine interface. These systems will fundamentally alter the mechanism of control for advanced systems across many applications. A significant focus will be on energy and national security systems.

These commercially available robots, upgraded with sensors and proprietary software developed at INL, demonstrate superior flexibility and autonomous behavior under critical human/machine interface conditions.

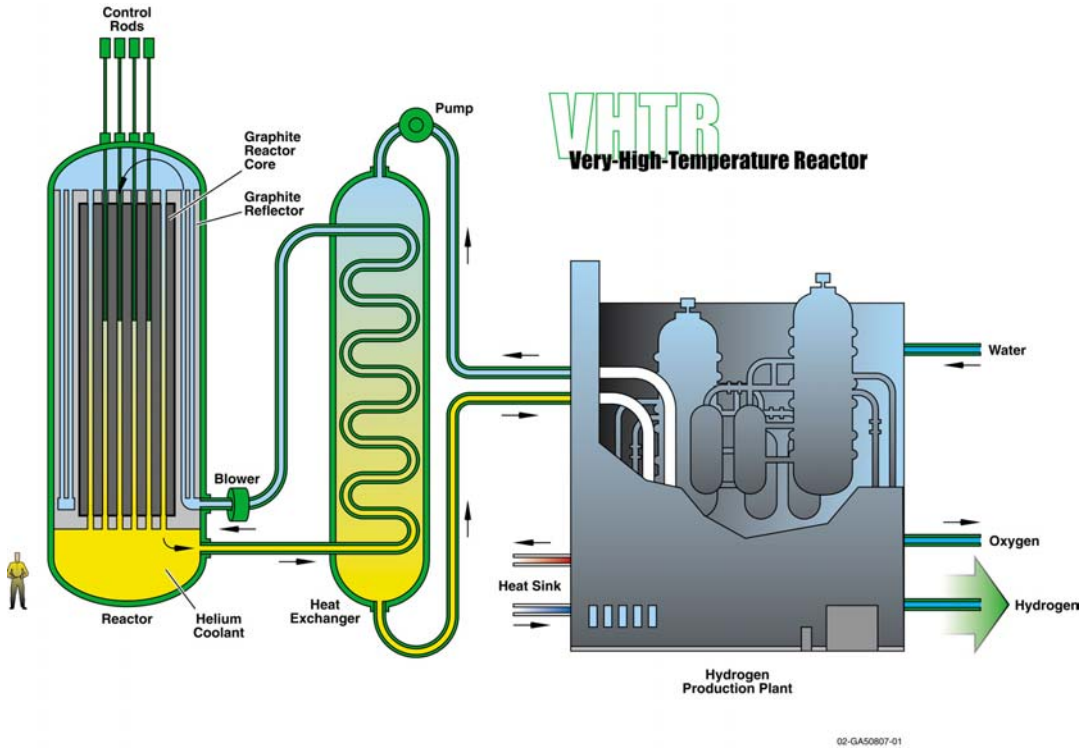
Strong Engineering Base

Strategic Objective –

Maintain and Enhance a Strong Engineering Base

For more than five decades, the laboratory has undertaken large-scale projects that have translated science into engineered systems, earning significant national and international recognition in nuclear energy. Revitalizing and expanding that engineering base is needed for successful execution of large projects. That foundation will help INL manage and deliver large-scale demonstration of nuclear, fossil, and renewable energy technologies, environmental stewardship and remediation technologies, space exploration, nuclear nonproliferation, critical infrastructure security, and other technologies important to the nation's energy security.

In particular, a large-scale Generation IV reactor demonstration project requires the highest levels of expertise in many engineering disciplines and specialties. In return, such projects attract talent from world-class engineering institutions that seek the experience of testing and proving technologies.



A Very-High Temperature Reactor system for the production of hydrogen to meet industrial and transportation needs.

Revitalize U.S. Nuclear Education and Training

Strategic Objective –

Revitalize Nuclear Science and Engineering Education and Training

America's nuclear science and technology future requires vibrant educational, research, and training institutions—institutions that prepare talented young people and that enable significant professional growth of scientists and engineers. The laboratory's engaging research opportunities, internships, mentoring, and close connectivity with researchers will reach out and inspire young people to choose nuclear research and related careers.

Revitalizing U.S. nuclear science and engineering education and research nationally is a challenging objective that will require a sustained commitment. Given its leadership role, INL, in partnership with DOE-NE University Programs, will guide and support this effort. Universities will be closely involved in all INL R&D activities, thus building the relationship between the laboratory and universities. While the challenge is substantial, the benefits to INL are significant and will be a key to reaching preeminence among peer institutions.

NUC/IUC member universities.

To meet this challenge, INL is establishing two university consortia—The National University Consortium (NUC), with five leading university partners, and the Idaho University Consortium (IUC), with three Idaho universities—that are designed to bring close university involvement

Through summer research internships, INL helps prepare talented young people for America's nuclear science and technology future.

in the research, educational, and outreach activities of the laboratory. One of the early activities of these consortia is to become involved in the planning and development of the nine research centers discussed in other sections. For example, the IUC has a leadership role in defining and developing the technical and physical infrastructure of the Center for Advanced Energy Studies. Another early consortia activity is to establish Academic Centers of Excellence on member campuses by 2007, through which research, joint appointments, campus user facilities, and other collaborations will be established to meet the nation's need to expand the nuclear science and engineering base. In this way, state-of-the-art integrated educational resources, academic partnerships, and programs will connect university faculty and students, nuclear industry professionals, and precollege teachers to INL researchers and facilities.

The laboratory can lead a nuclear energy renaissance only if talented and bright people are attracted to nuclear energy careers. Working with the IUC, the laboratory will help deliver nuclear science and engineering degree programs at all levels. Working with the NUC, those degree programs across the nation will be revitalized. Involvement of faculty in the research at INL will invigorate laboratory programs, while helping to fill the educational pipeline with the engineers and scientists needed tomorrow by all sectors.

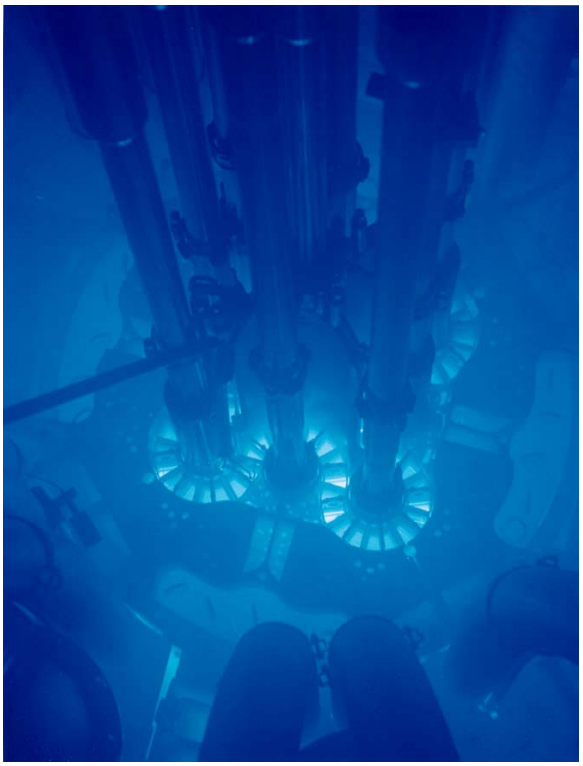
Establish Resource Networks

Strategic Objective –

Establish and Apply Three Resource Networks

INL will build three resource networks nationally to energize the delivery of new nuclear science and engineering technology. These networks—academic, industrial, and laboratory—will enable unprecedented collaborations through their capacity and agility to mobilize talent, ideas, and interest in nuclear science and engineering programs. The networks are vital for the delivery of large-scale projects and optimal engagement of national and international facilities, and will considerably leverage INL's technical strengths beyond Idaho. The networks will initially focus on INL assets, such as the Advanced Test Reactor (for the industrial network), the Center for Advanced Energy Studies (for the academic network), and the large-scale demonstration projects, such as a Generation IV reactor and the Advanced Fuel Cycle Facility (for the laboratory network).

These resource networks should be active by 2007. The industrial network is getting underway with the co-location of the Electric Power Research Institute (EPRI) Fuel Reliability Program at INL in 2005 and will strengthen with the designation of the Advanced Test Reactor as a national user facility in 2007. The laboratory network is already quite active, but will expand with the larger demonstration activity associated with the technology decision on the VHTR before the end of the decade.



The core of the Advanced Test Reactor (ATR) at the INL. ATR will be an initial focus of INL's strategic networks, including academic, industrial, and national laboratories. These networks will deliver new nuclear technologies to address national energy needs.

Key Milestones for Science and Engineering Capabilities –

- Develop distinctive scientific signature roadmaps 2005
- Create the Center for Advanced Energy Studies (CAES) 2005
- Create the academic network led by the National University Consortium (NUC) and the Idaho University Consortium (IUC) 2005
- Create the Center for Advanced Modeling and Simulation (CAMS) 2006
- Begin NUC Academic Centers of Excellence based on campus facilities 2007
- Select technology for the VHTR and start up the laboratory network 2007
- Complete the CAES building 2008
- Fully implement the distinctive scientific signatures' roadmaps 2010
- Grow science and technology programs to $70M annually 2015

Public Trust and Confidence, and World-Leading Safety, Environmental, and Operational Excellence

The foundation for successfully implementing INL's Strategic Plan is a set of *critical enablers*—public confidence; safety, environmental, and operational performance; the laboratory's infrastructure and research centers—that crosscut organizational boundaries and support the transformation to a world-class laboratory. The laboratory's infrastructure itself consists of four major elements: human capital, workplace facilities and environment, management systems, and information technology.

Middle school children pay close attention to a demonstration during INL's annual Science and Engineering Expo, an outreach experience that exposes students, teachers and parents to a diverse range of potential careers in science, mathematics, engineering and technology.

Strategic Objective –

Develop Public Trust and Confidence in INL and Nuclear Energy

Leading the nuclear renaissance brings unprecedented opportunity to serve the nation, but also the responsibility to earn public trust. Honest, timely, and accurate information about the laboratory's mission, strategy, performance, and impact—regionally, nationally, and internationally—will build stakeholder and public support for INL. With excellent operational and safety performance, substantial technical achievements, and the visible advancement of energy security by the world's nuclear energy community, accomplishing this objective will earn public trust and build confidence in nuclear energy.

Strategic Objective –

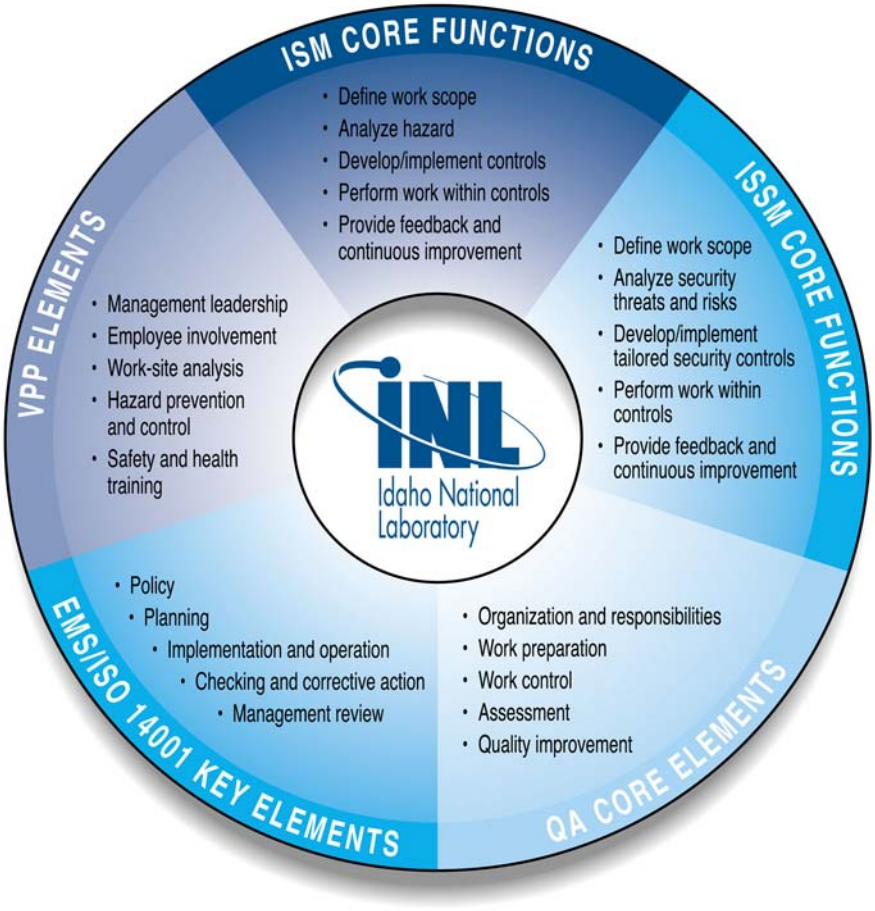
Demonstrate World-Leading Safety, Environmental, and Operational Performance

Revitalization of nuclear energy can only be achieved by meeting goals for the highest levels of safety, security, environmental protection, and operational performance. They are also key to building public trust and confidence. Each individual at INL will demonstrate leadership, superior safety, and sound environmental management; seek open dialogue with stakeholders; and be involved with peers to achieve these goals. The following are key to world-leading performance:

- Viewing all injuries as preventable and working with a vision of zero injuries
- Fostering open communications with stakeholders and partnering with the State of Idaho and DOE to address environmental matters

In July, 2004, DOE awarded the INL Star status—recognition for outstanding protection of employee safety and health. The laboratory plans to pursue recertification in 2006.

- Managing environmental stewardship by actively resolving legacy environmental issues
- Planning new nuclear missions enlightened by safety, security, and environmental responsibility
- Integrating safety management and human performance principles into all work planning and execution, including the achievement of ISO 14001 registration, ISM verification, and Voluntary Protection Program (VPP) STAR recertification
- Exhibiting the highest standards of performance in every aspect of laboratory operations.



EMS = Environmental Management System
ISM = Integrated Safety Management
ISSM = Integrated Safeguards and Security Management
QA = Quality Assurance
VPP = Voluntary Protection Program

The Integrated Safety Management System (ISMS) is designed to integrate all the elements of environment, safety, health, quality, and safeguards and security into one system. INL's application of ISMS will achieve world-leading safety, security, environmental, and operational performance.

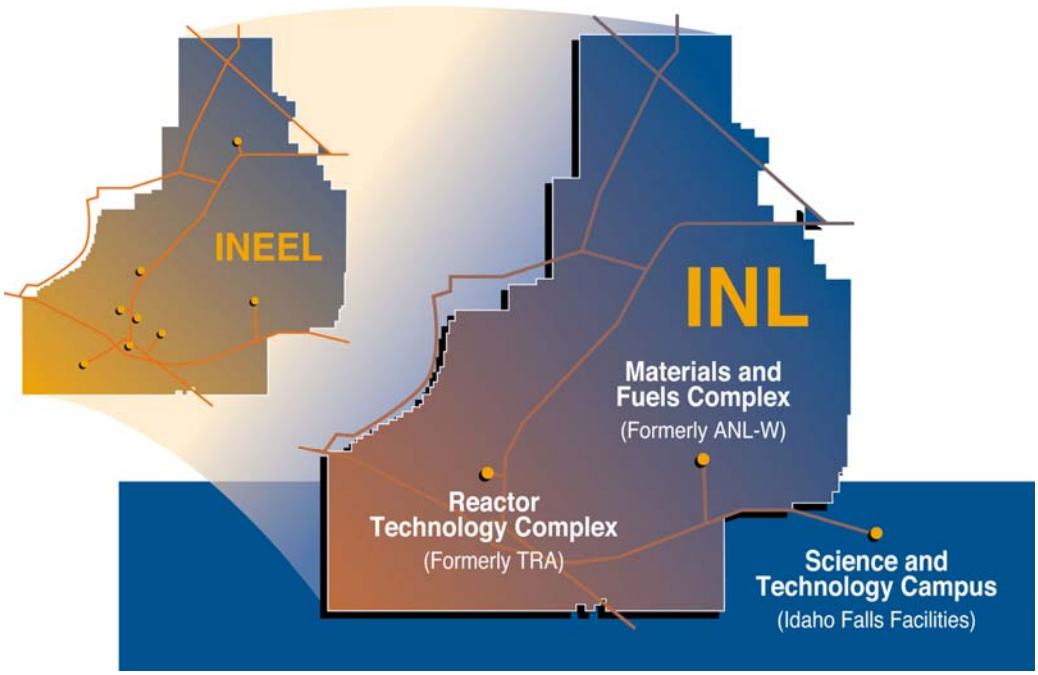
Modern Infrastructure

Strategic Objective –

Create Three Modern Laboratory Campuses

The aging laboratory facilities built by many programs over the last fifty years cannot support the new research directions of the 21st century. INL will consolidate and modernize its physical infrastructure into three state-of-the-art research campuses over ten years. These campuses will offer researchers modern facilities and equipment, and an open layout that stimulates peer interaction. These include the Reactor Technology Complex (RTC), Materials and Fuels Complex (MFC), and Science and Technology Campus (STC). This objective has the following aims:

- Provide new research facilities for mission support and growth that will attract and retain outstanding scientists with a new engineering facility in 2008 at RTC (with significant ATR upgrades by 2010), a science and technology facility in 2008, and a classified research facility in 2009 at STC
- Optimize facilities to support multiple program needs
- Modernize or replace obsolete facilities required by INL programs
- Inactivate, demolish, or transfer facilities no longer required by INL programs.



INL's size, remoteness, and variety of self-contained facilities make it an attractive site for mission-critical research, development, testing, and demonstration. The core of INL facilities are three mission-driven laboratory campuses.

Strategic Objective –

Develop, Recruit, and Retain a World-Class Workforce

INL must develop, recruit, and retain a world-class work force. To accomplish this, INL will make the human capital investment necessary for mission accomplishment and personal success for its employees. In addition to attractive benefits, compensation, recruitment, and organizational development programs, the investment will address diversity initiatives, succession planning, critical skills retention, human development programs, and leadership/management development.

For over 25 years, INL has sponsored an average of 250 summer student interns, post-doc and international researchers, university faculty, secondary school teachers, and high school students in educational programs and research laboratories.

Using program funding, Laboratory Directed Research and Development projects, savings reinvestment, and university networks, the laboratory will develop current staff and add new staff, hiring the best and brightest graduating students. Special emphasis will be on adding *strategic hires*—senior scientists or engineers with a national and/or international reputation—each year for a total of fifty at the end of five years.

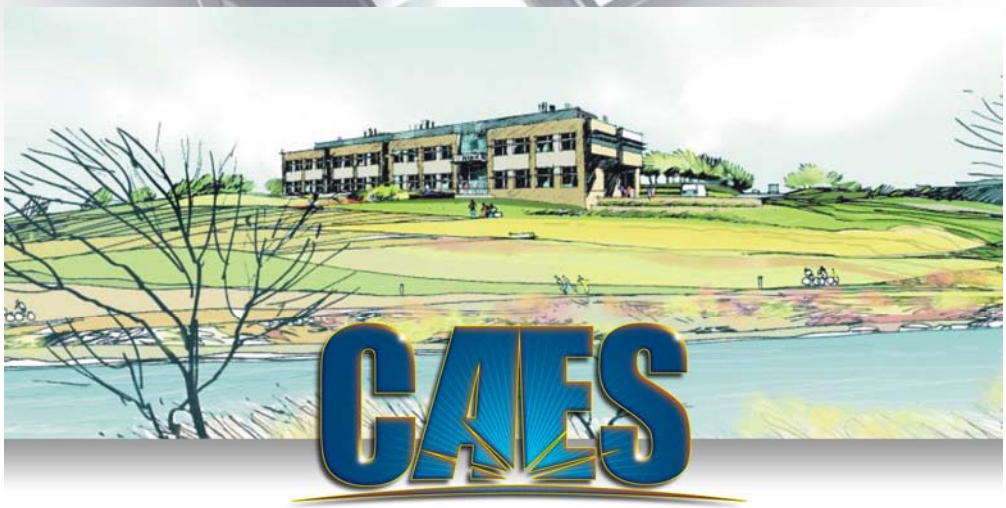
Strategic Objective –

Adopt Best-in-Class Laboratory Management Systems and Information Technology

The management systems and information technology must deliver the tools and efficiencies necessary to accomplish the mission. INL is committed to developing these efficient, effective, and on-demand management systems and information technologies. To meet the challenge, aggressive effort in redesigning these systems will contribute a ten-year cumulative reinvestment in the laboratory of $200M. This objective will:

- Identify resources for reinvestment in the laboratory
- Enhance INL's high-performance computing and collaboration capabilities
- Create best-in-class standards-based management and information technology systems
- Develop and begin implementation of a Battelle standards-based management system by 2008.

INL installed a high-performance computer cluster to enhance the laboratory's computing capability.



Research Centers and Centers of Excellence

Strategic Objective –

Establish and Leverage Nine Research Centers or Centers of Excellence

Several research centers or centers of excellence have been or will be created at INL. All of these share common goals: pursuing national and international research priorities, developing and enhancing capabilities, advancing the laboratory's reputation and recognition, growing robust programs and portfolios, and forging and leveraging the collaborative partnerships to accomplish them.

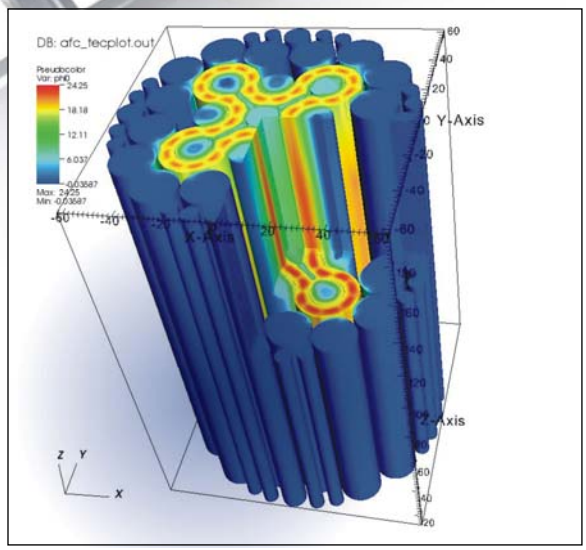
The Center for Advanced Energy Studies (CAES) was started in June 2005 as a vital education and research enterprise and a gateway to INL's research competencies. During the next decade, CAES will emerge as an independent Joint Institute for Advanced Energy Studies, involving Idaho, United States, and international centers of research to contribute to energy education, policy studies, research, and training.

In total, nine research centers or centers of excellence are planned, all of which are referenced in this plan:

- 2005—Center for Nuclear Fuel and Materials Research (CNFMR)
- 2005—Center for Space Nuclear Research (CSNR)
- 2006—Center for Nuclear Systems Design and Analysis (CNSDA)

Conceptual design of the radioisotope-powered New Horizons space craft expected to launch to Pluto in early 2006.

- 2006—Center for Advanced Modeling and Simulation (CAMS)
- 2008—Center for Advanced Energy Studies (CAES) building completion
- 2008—Center of Excellence for Critical Infrastructure Protection
- 2009—Center of Excellence for Nonproliferation Safeguards and Security
- 2010—Center of Excellence for Electric Grid Reliability
- ~2010—Advanced Fuel Cycle Facility (AFCF) pilot operations.



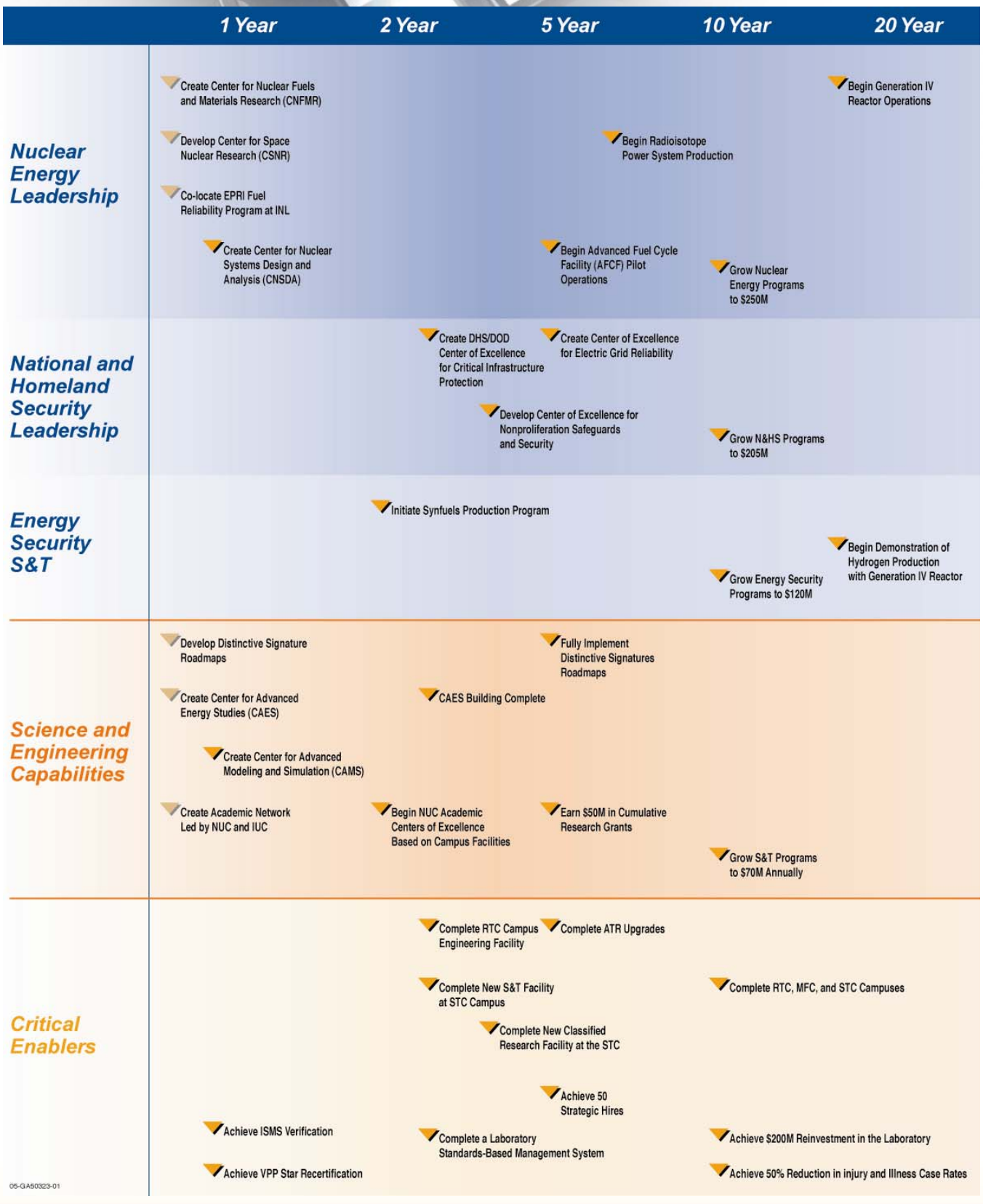
The Center for Advanced Modeling and Simulation will support deployment of advanced modeling and visualization technology for core analysis (represented above) and future plant design, and will help create the design basis criteria for advanced nuclear power systems.

Key Milestones to Enable the INL Strategy –

- Achieve ISO 14001 registration 2005
- Achieve ISMS verification 2006
- Achieve Voluntary Protection Program STAR recertification 2006
- Complete new engineering facility at the Reactor Technology Complex (RTC)..... 2008
- Complete new science and technology facility at the Science & Technology Campus (STC) 2008
- Complete implementation of a standards-based management system..... 2008
- Complete new classified research facility at STC 2009
- Achieve fifty strategic hires..... 2010
- Achieve 50% reduction in injury and illness case rates 2015
- Achieve $200M reinvestment in the laboratory..... 2015

The "INL Timeline for Transformation" on the following page, highlights key milestones planned for the next ten years and beyond. Achievement of these milestones will help ensure that DOE's vision for the INL is achieved.

INL TIMELINE FOR TRANSFORMATION



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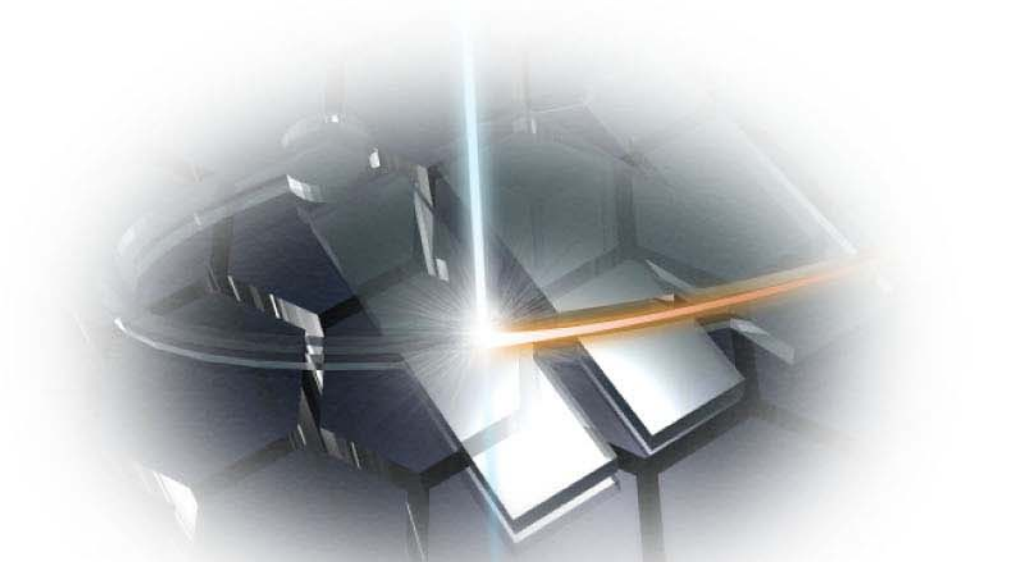

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